

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/18797

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H05H 1/00; H01L 21/00

US CL : 156/845; 118/728E; 728R

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

US : 156/845; 118/728E; 728R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

search terms: plasma, electrode, endpoint, impedance

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,707,485 A (ROLFSON et al) 13 January 1998, see cols. 5-6.	14
Y		15-17
X	US 5,542,559 A (KAWAKAMI et al) 06 August 1996, cols. 5-6.	20
X	US 5,576,629 A (TURNER et al) 19 November, 1996, see the entire document.	23-43



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"A" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

02 AUGUST 2001

Date of mailing of the international search report

05 SEP 2001

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 805-8280

Authorized officer

Thi Dang

Telephone No.

(703) 308-0661

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/18797

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 5,480,052 A (FURR et al) 02 January 1996, see the entire document.	11,18 ----- 4, 7, 9, 10, 12, 13, 15-17, 19

ENT COOPERATION TRE,

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

Date of mailing (day/month/year) 10 July 2001 (10.07.01)	
International application No. PCT/US00/18797	Applicant's or agent's file reference NOR-933WO
International filing date (day/month/year) 10 July 2000 (10.07.00)	Priority date (day/month/year) 13 July 1999 (13.07.99)
Applicant TYLER, James, Scott	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 12 February 2001 (12.02.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer H. Zhou Telephone No.: (41-22) 338.83.38
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PCT

REC'D 20 NOV 2001

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

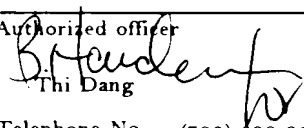
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference NOR-985WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/18797	International filing date (day/month/year) 10 JULY 2000	Priority date (day/month/year) 13 JULY 1999
International Patent Classification (IPC) or national classification and IPC IPC(7): H05H 1/00; H01L 21/00 and US Cl.: 156/345; 118/723E, 723R		
Applicant NORDSON CORPORATION		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets.
- ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of 0 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability, citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 12 FEBRUARY 2001	Date of completion of this report 31 OCTOBER 2001
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer  Thi Dang
Facsimile No. (703) 305-3230	Telephone No. (703) 308-0661

I. Basis of the report1. With regard to the **elements** of the international application: *

- ☒ the international application as originally filed
- ☒ the description:
pages 1-30 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____
- ☒ the claims:
pages 31-42 , as originally filed
pages NONE , as amended (together with any statement) under Article 19
pages NONE , filed with the demand
pages NONE , filed with the letter of _____
- ☒ the drawings:
pages 1-8 , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____
- ☒ the sequence listing part of the description:
pages NONE , as originally filed
pages NONE , filed with the demand
pages NONE , filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

- ☒ the description, pages NONE
- ☒ the claims, Nos. NONE
- ☒ the drawings, sheets/fig NONE

5. ☐ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

**Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/18797

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. statement

Novelty (N)

Claims	<u>1-19, 21, 22</u>	YES
Claims	<u>11-14, 20, 23-43</u>	NO

Inventive Step (IS)

Claims	<u>1-10, 15-19, 21, 22</u>	YES
Claims	<u>11-14, 20, 23-43</u>	NO

Industrial Applicability (IA)

Claims	<u>1-43</u>	YES
Claims	<u>NONE</u>	NO

2. citations and explanations (Rule 70.7)

Claims 1-10, 15-19, 21, and 22 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a plasma processing apparatus having a vacuum distribution baffle arranged between the vacuum port and the workpiece holder, and a powered electrode positioned between the vacuum baffle and the workpiece holder.

Claim 20 lacks novelty under PCT Article 33(2) as being anticipated by Kawakami et al.

Kawakami discloses a plasma processing method that includes supplying process gas through an array of apertures facing the workpiece, and applying power to generate plasma from the process gas.

Claims 23-43 lack novelty under PCT Article 33(2) as being anticipated by Turner et al.

Turner discloses a method of detecting an endpoint of a plasma treatment which includes all of the claimed features including matching the impedance to a desired value and controlling the RF power. Controlling the RF power would include increasing the RF power.

Claim 14 lacks an inventive step under PCT Article 33(3) as being obvious over Rolfson et al.

Rolfson discloses a plasma processing apparatus that has two electrodes arranged on opposite sides of a workpiece, and power supply means for applying power to the electrodes so as to generate plasma between the electrodes. Even though the power supply is connected to both electrodes in Rolfson's apparatus, it would have been obvious to have one of the electrodes grounded because it is known in the art that plasma can be generated between a powered electrode and a grounded electrode.

Claims 11, 12, 13 lack an inventive step under PCT Article 33(3) as being obvious over Furr et al.
(Continued on Supplemental Sheet.)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/18797

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):

Furr discloses a plasma processing chamber having a chamber lid, which is connected to the chamber base by a hinge. It would have been obvious to provide a sealing member and around bearing groove for the hinge of Furr's apparatus because these features are conventional in the art to provide proper closing of the chamber lid.

----- NEW CITATIONS -----

US 5,707,485 A (ROLFSON et al) 13 January 1998, see cols. 5-6.

US 5,542,559 A (KAWAKAMI et al) 06 August 1996, see cols. 5-6.

US 5,576,629 A (TURNER et al) 19 November 1996, see the entire document.

US 5,480,052 A (FURR et al) 02 January 1996, see the entire document.

(19) World Intellectual Property Organization
International Bureau



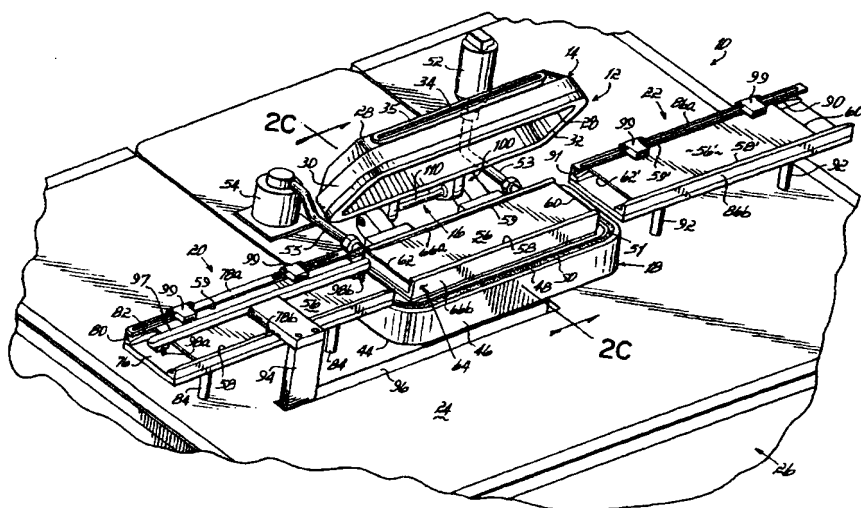
(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/05197 A2

- (51) International Patent Classification⁷: **H05H** [US/US]: 141 South Emerald Oak Drive, Galt, CA 95632 (US).
- (21) International Application Number: PCT/US00/18797
- (22) International Filing Date: 10 July 2000 (10.07.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/143,577 13 July 1999 (13.07.1999) US
- (71) Applicant (for all designated States except US): **NORDSON CORPORATION** [US/US]: 28601 Clemens Avenue, Westlake, OH 44145 (US).
- (74) Agents: **ROONEY, Kevin, G. et al.**: Wood, Herron & Evans, L.L.P., 2700 Carew Tower, Cincinnati, OH 45202 (US).
- (81) Designated States (national): JP, KR, US.
- (84) Designated States (regional): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).
- Published:**
— Without international search report and to be republished upon receipt of that report.
- (72) Inventor; and
(75) Inventor/Applicant (for US only): **TYLER, James, Scott**
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HIGH-SPEED SYMMETRICAL PLASMA TREATMENT SYSTEM



(57) Abstract: A plasma treatment system (10) and related methods for rapidly treating a workpiece (56) with ions from a plasma having an ion density that is reproducibly uniform and symmetrical. The processing chamber (12) of the plasma treatment system (10) includes a chamber (14) lid having a symmetrical array of apertures (192) and further includes a vacuum distribution baffle (180), which are both configured to uniformly disperse a process gas adjacent the surface of the workpiece (56). The uniform dispersion of process gas and a symmetrical placement of the workpiece within the chamber (12) contribute to providing a uniformly dense plasma of ions adjacent the workpiece (56). A treatment system control (304) automates the operation of the system and controls the flow of process gas, evacuation of the chamber, and the application of the plasma excitation power to minimize the length of a treatment cycle and to optimize the uniformity of the plasma treatment.

WO 01/05197 A2

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 06 MAY 2002

PCT


Applicant's or agent's file reference NOR-938WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/18797	International filing date (day/month/year) 10 JULY 2000	Priority date (day/month/year) 13 JULY 1999
International Patent Classification (IPC) or national classification and IPC IPC(7): H05H 1/00; H01L 21/00 and US CL: 156/345; 118/723E, 723R		
Applicant NORDSON CORPORATION		

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2. This REPORT consists of a total of 4 sheets.
- ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority. (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).
- These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of report with regard to novelty, inventive step or industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

CORRECTED
VERSION

Date of submission of the demand 12 FEBRUARY 2001	Date of completion of this report 31 OCTOBER 2001
Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer Thi Dang 
Facsimile No. (703) 305-3230	Telephone No. (703) 305-0661

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/18797

I. Basis of the report

1. With regard to the **elements** of the international application: *☐ the international application as originally filed☒ the description:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

☒ the claims:

pages (See Attached)

, as originally filed

pages , as amended (together with any statement) under Article 19

pages , filed with the demand

pages , filed with the letter of

☒ the drawings:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

☒ the sequence listing part of the description:

pages (See Attached)

, as originally filed

pages , filed with the demand

pages , filed with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).☐ the language of publication of the international application (under Rule 48.3(b)).☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:☐ contained in the international application in printed form.☐ filed together with the international application in computer readable form.☐ furnished subsequently to this Authority in written form.☐ furnished subsequently to this Authority in computer readable form.☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.4. ☒ The amendments have resulted in the cancellation of:☒ the description, pages NONE☒ the claims, Nos. NONE☒ the drawings, sheets/fig NONE5. ☐ This report has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)). **

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

**Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/18797

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. statement**

Novelty (N)	Claims	<u>1-10, 15-19, 21-22</u>	YES
	Claims	<u>11-14, 20, 23-43</u>	NO
Inventive Step (IS)	Claims	<u>1-10, 15-19, 21-22</u>	YES
	Claims	<u>11-14, 20, 23-43</u>	NO
Industrial Applicability (IA)	Claims	<u>1-43</u>	YES
	Claims	<u>NONE</u>	NO

2. citations and explanations (Rule 70.7)

Claims 1-10, 15-19, 21, and 22 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a plasma processing apparatus having a vacuum distribution baffle arranged between the vacuum port and the workpiece holder, and a powered electrode positioned between the vacuum baffle and the workpiece holder.

Claim 20 lacks novelty under PCT Article 33(2) as being anticipated by Kawakami et al.

Kawakami discloses a plasma processing method that includes supplying process gas through an array of apertures facing the workpiece, and applying power to generate plasma from the process gas.

Claims 23-43 lack novelty under PCT Article 33(2) as being anticipated by Turner et al.

Turner discloses a method of detecting an endpoint of a plasma treatment which includes all of the claimed features including matching the impedance to a desired value and controlling the RF power. Controlling the RF power would include increasing the RF power.

Claim 14 lacks an inventive step under PCT Article 33(3) as being obvious over Rolfson et al.

Rolfson discloses a plasma processing apparatus that has two electrodes arranged on opposite sides of a workpiece, and power supply means for applying power to the electrodes so as to generate plasma between the electrodes. Even though the power supply is connected to both electrodes in Rolfson's apparatus, it would have been obvious to have one of the electrodes grounded because it is known in the art that plasma can be generated between a powered electrode and a grounded electrode.

Claims 11, 12, 13 lack an inventive step under PCT Article 33(3) as being obvious over Furr et al.
(Continued on Supplemental Sheet.)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US00/18797

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Boxes I - VIII

Sheet 10

I. BASIS OF REPORT:

This report has been drawn on the basis of the description,
page(s) 1-30, as originally filed.
page(s) NONE, filed with the demand.
and additional amendments:
NONE

This report has been drawn on the basis of the claims,
page(s) 31-33, 35, 38, 41-42, as originally filed.
page(s) NONE, as amended under Article 19.
page(s) NONE, filed with the demand.
and additional amendments:
Pages 34, 36-37a, 39-40a, filed with the letter of 05 October 2001.

This report has been drawn on the basis of the drawings,
page(s) 1-8, as originally filed.
page(s) NONE, filed with the demand.
and additional amendments:
NONE

This report has been drawn on the basis of the sequence listing part of the description:
page(s) NONE, as originally filed.
pages(s) NONE, filed with the demand.
and additional amendments:
NONE

V. 2. REASONED STATEMENTS - CITATIONS AND EXPLANATIONS (Continued):

Furr discloses a plasma processing chamber having a chamber lid, which is connected to the chamber base by a hinge. It would have been obvious to provide a sealing member and abround bearing groove for the hinge of Furr's apparatus because these features are conventional in the art to provide proper closing of the chamber lid.

----- NEW CITATIONS -----

US 5,707,485 A (ROLFSON et al) 13 January 1998, see cols. 5-6.

US 5,542,559 A (KAWAKAMI et al) 06 August 1996, see cols. 5-6.

US 5,576,629 A (TURNER et al) 19 November 1996, see the entire document.

US 5,480,052 A (FURR et al) 02 January 1996, see the entire document.

14. An apparatus for processing a workpiece with a process gas, comprising:

a chamber having a processing space and a workpiece holding portion configured to receive the workpiece;

5 a gas supply in fluid communication with the vacuum chamber, said gas supply operable to selectively provide a process gas into the processing space;

a powered electrode positioned on one side of said workpiece holding portion;

10 a plasma excitation source operably connected to said powered electrode assembly for exciting the process gas within said processing space to generate a plasma; and

a ground electrode positioned on an opposite side of said workpiece holding portion relative to said powered electrode, said powered
15 electrode and said ground electrode being approximately equidistant from said workpiece holding portion, said powered and ground electrodes together producing an electric field substantially perpendicular to said workpiece when said workpiece is received in said workpiece holding portion.

15. The apparatus of claim 14, wherein said chamber includes a lid
20 movable between open and closed positions for introducing and removing the workpiece to and from said workpiece holding portion of said processing space, said lid further comprising said ground electrode.

16. The apparatus of claim 15, wherein said lid further includes a process gas inlet port for introducing process gas to said processing space.

19. The apparatus of claim 18, wherein said lid includes an interior surface facing said workpiece holding portion of said processing space when said lid is in said closed position, and said process gas inlet port further comprises a gas distribution space within said lid and an array of apertures on
5 said interior surface configured to uniformly distribute the process gas from said gas distribution space onto the workpiece.

20. A method for treating a workpiece with a plasma, comprising:
positioning a workpiece on a workpiece-holding portion within a processing space of a vacuum chamber, said vacuum chamber having an
10 interior surface facing said workpiece holding portion wherein said interior surface including an array of apertures configured to uniformly distribute said process gas about said surface of said workpiece;
evacuating the processing space;
initiating a flow of a process gas through said array of apertures
15 into the processing space, wherein said flow lines of process gas are symmetrical over the surface of the workpiece; and
applying plasma excitation power to create a plasma from the process gas in the processing space.

21. A method for treating a workpiece with a plasma, comprising:
20 positioning a workpiece on a workpiece-holding portion within a processing space of a vacuum chamber;
initiating a flow of a process gas into said processing space
evacuating the processing space through a vacuum port in fluid communication with said vacuum chamber, said chamber further including a
25 vacuum distribution baffle positioned between said vacuum port and said workpiece-holding portion, wherein said baffle provides symmetrical lines of flow of said process gas over said surface of said workpiece; and
applying plasma excitation power to create a plasma from the process gas in the processing space.

22. The method of claim 21, wherein said vacuum distribution baffle comprises an electrically-insulating material and said baffle is operable to confine said plasma to a portion of said processing space adjacent said workpiece holding portion.

- 5 23. A method of operating a plasma treatment system comprising:
transferring a workpiece to be processed into a processing
chamber;
decreasing pressure within the processing chamber;
initiating a flow of process gases into the processing chamber;
10 applying an RF power of a relatively-low power level to
electrodes within the processing chamber to create a gas plasma, thereby
initiating a plasma treatment cycle;
matching an impedance of an RF system including the
electrodes at the relatively-low power level to a desired impedance;
15 increasing RF power to the electrodes from the relatively-low
power level to a relatively-high power level;
continuously matching the impedance of the RF system to the
desired impedance while increasing the RF power to the electrodes;
maintaining the RF power at the relatively-high power level;
20 continuously matching the impedance while maintaining the RF
power to the electrodes at or near the relatively-high power level;
detecting an end of the plasma treatment cycle; and
terminating the flow of process gases to the processing
chamber and the application of RF power to the electrodes after detecting the
25 end of the plasma treatment cycle.

24. The method of operating a plasma treatment system of claim 23 further comprising decreasing RF power to the electrodes in response to detecting an end of the plasma treatment cycle.

25. The method of operating a plasma treatment system of claim 23 further comprising increasing RF power to the electrodes at a maximum rate permitting a continuous matching of the impedance of the RF system to the desired impedance.

30. A method of operating a plasma treatment system comprising:
transferring a workpiece to be processed into a processing
chamber;
evacuating the processing chamber to an upper pressure limit;
5 initiating a flow of process gases into the processing chamber;
applying RF power to electrodes within the processing chamber
to create a gas plasma, thereby initiating a plasma treatment cycle;
matching an impedance of an RF system including the
electrodes to a desired impedance;
10 continuing to evacuate the processing chamber during the
plasma treatment cycle to a pressure greater than or equal to a lower
pressure limit while continuously matching the impedance of the RF system to
the desired impedance;
detecting an end of the plasma treatment cycle; and
15 terminating the flow of process gases to the processing
chamber and the application of RF power to the electrodes after detecting the
end of the plasma treatment cycle.

31. The method of operating a plasma treatment system of claim 30
further comprising the steps of monitoring pressure within the processing
20 chamber at least between the upper and lower pressure limits and controlling
the flow of process gases into the processing chamber based on the
monitored pressure.

32. The method of operating a plasma treatment system of claim 30
wherein the upper pressure limit equals a normally used processing pressure
25 value plus an incremental offset pressure value.

33. The method of operating a plasma treatment system of claim 32
wherein the lower pressure limit equals the normally used processing
pressure value minus the increment offset pressure value.

34. The method of operating a plasma treatment system of claim 33 further comprising increasing pressure in the processing chamber after detecting the end of the plasma treatment cycle.

35. A method of operating a plasma treatment system comprising:
transferring a workpiece to be processed into a processing
chamber;
operating a vacuum system to decrease pressure within the
5 processing chamber to a first partial vacuum;
operating a mass flow controller to initiate a flow of process
gases into the processing chamber;
operating in response to the first partial vacuum in the chamber
an RF generator to apply RF power of a lesser, first power level to electrodes
10 within the processing chamber to create a gas plasma, thereby initiating a
plasma treatment cycle;
operating a tuning network to match an impedance of an RF
system including the RF generator and the electrodes to a desired impedance
with the electrodes being supplied the first power level;
15 operating the RF generator to increase RF power to the
electrodes to a greater, second power level;
operating the tuning network to match the impedance of the RF
system to the desired impedance with the electrodes being supplied with the
second power level;
20 operating the RF generator to maintain the RF power at the
greater, second power level;
operating the vacuum system and the mass flow controller to
decrease pressure within the processing chamber to a second partial
vacuum;
25 continuously operating the tuning network to match the
impedance of the RF system to the desired impedance while maintaining the
RF power to the electrodes at the greater, second power level;
detecting an end of the plasma treatment cycle;
operating the mass flow controller to terminate the flow of
30 process gases to the processing chamber after detecting the end of the
plasma treatment cycle;

operating the RF generator to terminate the application of RF power to the electrodes after detecting the end of the plasma treatment cycle; and

- increasing pressure within the processing chamber to
- 5 approximately atmospheric pressure.